

REMARKS

This is intended as a full and complete response to the Office Action dated June 10, 2008, having a shortened statutory period for response set to expire on September 10, 2008. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1-30 are pending in the application and are shown above. Applicants have cancelled finally restricted claims 25-30. Applicants reserve the right to prosecute claims drawn to the subject matter of claims 25-30 in a divisional application. Claims 1 and 14 are amended to clarify the invention. Claims 1-24 stand rejected. Reconsideration of the rejected claims is requested for reasons presented below.

Rejections under 35 U.S.C. § 102

Claims 1, 4, 11-14, 16-19, and 21 are rejected under 35 U.S.C. § 102(b) as being anticipated by *Rajagopalan, et al.* (International Patent Publication No. WO 98/51838, hereinafter referred to as "Rajagopalan"), on grounds that Rajagopalan discloses the claimed invention. The Examiner asserts that Rajagopalan teaches a process for depositing a tungsten layer on a substrate, including heating the substrate, providing and removing a process gas consisting of tungsten hexafluoride and silane, wherein the removal lasts from about 3 to about 12 second. The Examiner equates introducing and removing the process gas from the chamber with controlling production of a concentration boundary layer. Applicants respectfully traverse the rejection.

Rajagopalan teaches a diborane presoak step as part of a process of depositing a tungsten film on a flat substrate. A gas mixture comprising diborane and hydrogen is provided to the deposition chamber for 10-20 seconds following nucleation with tungsten. The diborane presoak step forms a layer of diborane near the substrate surface, resulting in larger grain size, fewer impurities, and better film uniformity. Rajagopalan does not teach or show controlling production of a concentration boundary layer. Additionally, although Rajagopalan teaches that the diborane gas mixture flows

for 10-20 seconds, Rajagopalan does not teach or show removal of the process gas lasting from about 3 to about 12 seconds. Depending on numerous factors, for example, removal may take place over a shorter duration in Rajagopalan.

Applicants therefore submit that Rajagopalan does not teach, show, suggest, or make obvious a process for depositing a metal film on a substrate disposed in a processing chamber, said process comprising heating a substrate having openings for forming one or more vias; and introducing into, and removing from, said processing chamber, a process gas consisting of a metal source and a hydrogen source to nucleate said substrate with metal within the openings while controlling production of a concentration boundary layer by removing said process gas from said processing chamber after commencement of nucleation of said substrate, wherein removing said process gas from said processing chamber lasts from about 3 to about 12 seconds, as recited in claim 1 and claims dependent thereon.

Applicants further submit that Rajagopalan does not teach, show, suggest, or make obvious a process for depositing a metal film on a substrate disposed in a processing chamber, said process comprising heating a substrate having openings for forming one or more vias; and introducing into, and removing from, said processing chamber, a process gas consisting of a tungsten source and a hydrogen source to nucleate said substrate with tungsten by removing said process gas from said processing chamber after commencement of nucleation of said substrate with tungsten, wherein removing said process gas from said processing chamber lasts from about 3 to about 12 seconds, as recited in claim 14 and claims dependent thereon.

Applicants respectfully request the rejection be withdrawn.

Rejections under 35 U.S.C. § 103

Claims 3, 5, 6, 10, 20, 22, and 23 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rajagopalan as applied to claims 1 and 14 above, and further

in view of *Tseng, et al.* (EP Patent No. 0704551, hereinafter referred to as "Tseng"). The Examiner acknowledges that Rajagopalan does not teach pressurizing the chamber to a second pressure level less than the first pressure level, maintaining pressurization of the chamber at a constant level, introducing a purge gas into the chamber while decreasing pressurization of the chamber, a first pressurization of 15 Torr, or a second pressurization of 1-3 Torr. The Examiner asserts, however, that Tseng teaches flowing a purge gas while chamber pressure is maintained, and then again at a reduced pressure, and that it would have been obvious to apply this teaching from Tseng to the process of Rajagopalan to yield the claimed invention. The Examiner also asserts that the pressure parameters are result effective and subject to optimization by a person of ordinary skill. Applicants respectfully traverse the rejection.

Rajagopalan is discussed above. Tseng teaches purging a tungsten deposition chamber by flowing silane at a reduced pressure following deposition. Tseng does not disclose controlling production of a concentration boundary layer, nor removal of the process gas lasting from about 3 seconds to about 12 seconds. Thus, Tseng does not remedy the deficiency of Rajagopalan. Because Rajagopalan and Tseng, alone or in combination, do not teach, show, suggest, or make obvious each and every element of claims 3, 5, 6, and 10, depending on claim 1, and 20, 22, and 23, depending on claim 14, Applicants respectfully request the rejection be withdrawn.

Claims 2, 7, 8, 15, and 24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rajagopalan as applied to claims 1 and 14 above, and further in view of *Govindarajan, et al.* (US Patent No. 6,309,966 B1, hereinafter referred to as "Govindarajan"). The Examiner acknowledges that Rajagopalan does not teach multiple nucleation cycles, introducing the process gas for 3-5 seconds and removing it after 7-12 seconds, or varying the ratio of metal source to hydrogen source during successive cycles. The Examiner asserts, however, that Govindarajan supplies these elements, and that it would have been obvious to combine the teachings of

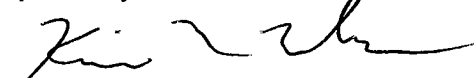
Govindarajan with those of Rajagopalan to yield the claimed invention. Applicants respectfully traverse the rejection.

Rajagopalan is discussed above. Govindarajan teaches a 2-step tungsten nucleation process in which the first nucleation cycle is performed at a low ratio of silane to tungsten source, and the second nucleation cycle is performed at a high ratio of silane to tungsten source. Govindarajan does not teach or show controlling production of a concentration boundary layer, or removal of the process gas lasting from about 3 to about 12 seconds. Thus, Govindarajan does not remedy the deficiency of Rajagopalan. Because Rajagopalan and Govindarajan, alone or in combination, do not teach, show, suggest, or make obvious each and every element of claims 2, 7, and 8, depending on claim 1, and 15 and 24, depending on claim 14, Applicants respectfully request the rejection be withdrawn.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

Having addressed all issues set out in the Office Action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,

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